(12) UK Patent Application (19) GB (11) 2 353 925 (13) A

(43) Date of A Publication 07.03.2001

(21) Application No 0016792.4

(22) Date of Filing 07.07.2000

(30) Priority Data
(31) 9916181 (32) 09.07.1999 (33) GB

(71) Applicant(s)
Simoco International Limited
(Incorporated in the United Kingdom)
PO Box 24, St. Andrews Road, CAMBRIDGE, CB4 1DP, United Kingdom

HW Communications Limited
(Incorporated in the United Kingdom)
1 Brettargh Close, Haverbreaks, LANCASTER, LA1 5BU, United Kingdom

(72) Inventor(s)
Mark Wentworth Rayne
Steven McBirnie
Mohan Indika Samarakoon

(51) INT CL[7]
H04N 7/52 // H03M 7/00 , H04B 14/06 , H04L 7/08

(52) UK CL (Edition S)
H4P PSB

(56) Documents Cited
None

(58) Field of Search
UK CL (Edition R) **H4M MTB1 MTB3 , H4P PDCFP PEP PSB**
INT CL[7] **H03M 7/00 , H04B 7/26 14/06 , H04L 7/04 7/08 , H04N 7/52 7/54 7/56**
Online Databases: WPI, EPODOC, JAPIO

(74) Agent and/or Address for Service
Frank B Dehn & Co
179 Queen Victoria Street, LONDON, EC4V 4EL, United Kingdom

(54) Abstract Title
Transmitting differentially encoded data

(57) A transmitted video data bit stream contains a stream of I, P and B frames, I frames being complete data frames and P and B frames being differentially coded data frames. I frames are sent less frequently in the stream than P and B frames because they contain more data. Encryption synchronisation frames are also transmitted throughout the transmission at intervals and together with the I frames allow users to join the transmission after the start and allow recovery from transmission errors. Encryption synchronisation frames 9 are sent immediately prior to I frames 8. This ensures that, no matter where a user begins receipt of the data bit stream 20, both an encryption synchronisation frame 9 and I frame 8 will be received in quick succession and decoding will commence with a minimum delay between receipt of the encryption frame and receipt of the I frame. The synchronisation frames 9 may also be sent at other rates, intervals or positions in the data stream in a predetermined relationship to the I frames.

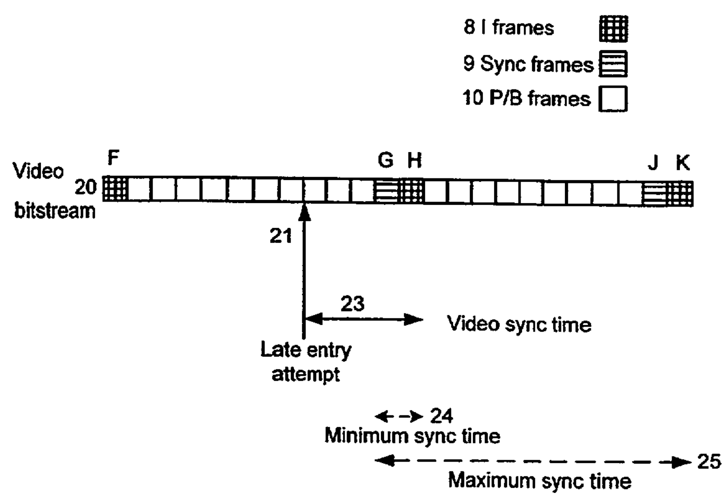

FIG.4

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

This print reflects amendment of the request for grant in accordance with Rule 35 of the Patents Rules 1995

GB 2 353 925 A

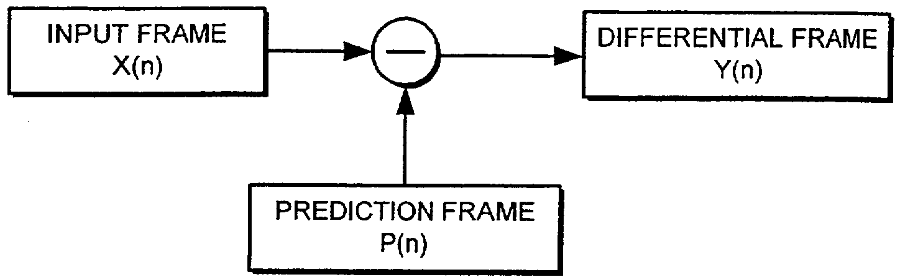

FIG.1

FIG.2

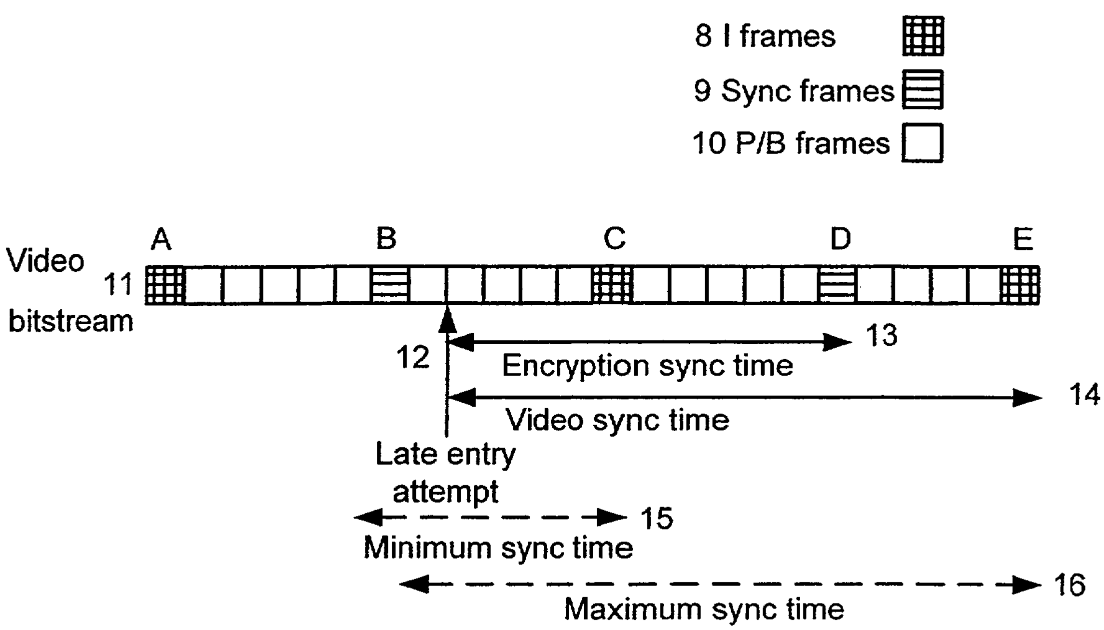

FIG.3

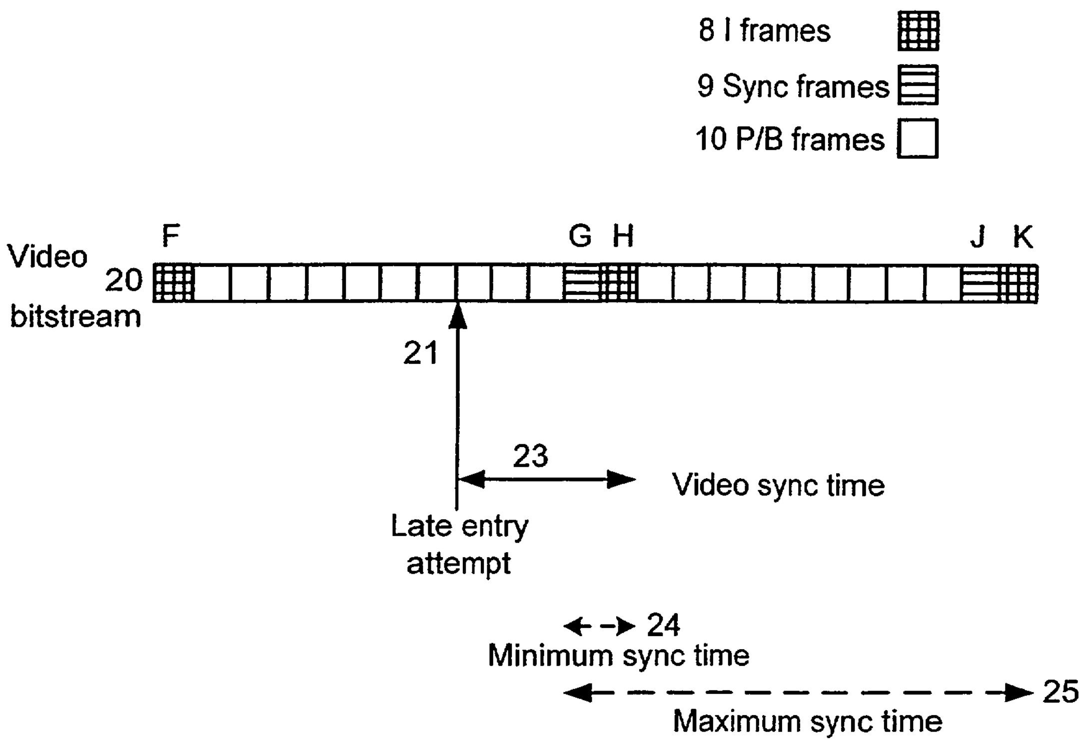
8 I frames
9 Sync frames
10 P/B frames
F
G H
J K
Video bitstream
20
21
23
Video sync time
Late entry attempt
24
Minimum sync time
25
Maximum sync time

FIG.4

METHOD OF AND APPARATUS FOR TRANSMITTING DATA

This invention relates to the field of transmitting data and, more particularly, to a method of and an apparatus for transmitting differentially encoded data.

As is known in the art, differential encoding involves comparing portions of data with one another and using information relating to the differences between the portions of data instead of the entire data portions themselves. Differentially encoded data therefore comprises a stream of differentially encoded information packets or differential data portions that only contain information relating to differences or changes between each respective data portion and other data portions. These differences may, for example, be the absolute differences between the actual values of the data portions. Alternatively, as is often the case in video encoding, the differences may be, for example, the differences between data values predicted for the particular data portion on the basis of other data portions and the actual data values for the particular data portion, or they may be differences relative to the last differential data portion.

Original data is reconstructed from differentially encoded data portions using the information in them relating to the differences or changes from the other data portions on which they are based (and any necessary prediction algorithm). Thus, all the original data corresponding to a differentially encoded data portion cannot be reconstructed from a differentially encoded data portion alone, but requires knowledge of the data portion or portions on which the differentially encoded data portion is based. The data portion or portions on which the differentially encoded data portion is based are often also themselves based on other data portions, and so on. Thus, the correct reconstruction of a differentially encoded data portion is often dependent on the data integrity of a large portion of the data stream, since correct reconstruction of a differentially encoded data portion can depend upon a number of preceding data portions being correctly received.

In view of this, a differentially encoded data transmission will include interspersed into the data stream complete data portions which contain all of the original data necessary to allow the data corresponding to that complete data portion to be entirely reconstructed using the complete data portion alone. These complete data portions help to ensure data integrity, since they allow the original data to be reconstructed without the need to have correctly received earlier data portions.

As differential data portions contain information relating only to differences or changes in the data, they can be considerably smaller than the complete data portions. This has the advantage of reducing or compressing the amount of encoded information, and is particularly advantageous for storing or transmitting data. More particularly, this is advantageous for radio transmissions for which bandwidth, and therefore the rate at which data can be transmitted, may be restricted.

However, complete data portions must still be transmitted, since, if any data portion is not received properly, both that data portion and additional differential data portions based on it become subject to errors. These errors can be compounded over successive data portions. Usually, it is only when a complete data portion, not reliant on another (erroneous) data portion, is received that errors stop being compounded, and data is correctly reconstructed. Complete data portions are therefore transmitted at intervals, usually fixed intervals, to reduce errors by limiting the number of successive data portions on which differential data portions rely. This also allows "late-entry" into the data transmission, i.e. reception can begin part way through the transmission, as each time a complete data portion is received successful decoding is not dependant on receipt of data portions before the complete data portion.

Thus, all differentially encoded data transmissions include, at intervals, non-differentially encoded data, i.e. complete data portions, to allow recovery of the data to limit signal quality degradation when data is lost and allow late-entry into a data transmission.

Differential encoding is used, for example, for the storage and transmission of video data, such as by the H.263, MPEG-1 and MPEG-2 standards. In these arrangements frames of video data are differentially encoded by subtracting a prediction frame from the input video frame. The prediction frame is formed from the previous (reconstructed) input frame. At the receiver, the frames are recreated by adding the received differentially encoded frame to the prediction frame (which is formed using the known prediction routine). Data to form a complete frame of video data will also be encoded intermittently as a complete data portion.

Generally, three types of frame are actually transmitted in differentially encoded video transmissions. An INTRA (I) frame is a coded frame which contains no predicted or differenced data, i.e. it is a complete data portion which is not dependent on any previous frame. An I frame therefore includes information relating to the entire content of that frame and can be said not to be differentially encoded. INTER (P) frames or bi-directionally predicted (B) frames are coded frames that relate to differences between a prediction frame created from video data in frames before the relevant frame, and in the case of B frames also frames generated after the relevant frame, and the actual data in the frame. Thus P and B frames are differential data portions. As P and B frames are considerably smaller than I frames, the overall amount of data transmitted or stored is reduced by using mostly P and B frames. However, complete, i.e. I, frames must still be transmitted at intervals to allow recovery of data and reduce picture quality degradation for the reasons discussed above.

Another aspect of data transmission is encryption synchronisation. Encrypted data transmission, including encrypted differentially encoded data transmission, usually requires the receiver or decoder to be synchronised with the transmission encryption, e.g. as regards the encryption key currently being used, or their position in a varying encryption algorithm, such as their position in a key stream cipher, to allow decryption of the encrypted data. Only a synchronised decoder may be able successfully to decode the transmission.

Thus, encryption synchronisation information is generally transmitted at the beginning of a transmission to allow receivers or decoders to synchronise with the transmission encryption to decode the data. It is also desirable to transmit encryption synchronisation information at intervals during a transmission, to avoid degradation or loss of a signal by loss of encryption synchronisation, and to allow users to join the transmission at a later time, i.e. to allow late-entry.

There are other types of synchronisation information that are also required to be transmitted at intervals during a transmission to allow synchronisation recovery or late-entry. For example, in some mobile communication systems, mobile units transmit frequency synchronisation information to allow receiving mobile units to tune into the exact frequency the transmitting mobile unit is using to transmit its signal. This frequency synchronisation information is transmitted as a frequency synchronisation burst of a few milliseconds duration at intervals during the transmission.

Such synchronisation information to be transmitted intermittently during a transmission of a data stream can be transmitted by adding the information to the data stream or by stealing from the data stream (i.e. by replacing a section of the transmitted data with the synchronisation data). This transmission of synchronisation information at intervals in the data stream should be distinguished from synchronisation information that is included in each data portion, such as video synchronisation information which may be included in each frame of video data, for example in a header of each frame, to allow synchronisation of the received decoded video data.

Thus, in order to successfully begin to decode an encrypted differentially encoded data transmission, a decoder must first receive encryption synchronisation information, and then receive a complete data portion, for example an I frame in a video transmission, before being able to decode properly the differentially encoded signal. The same is generally true in systems in which synchronisation information necessary to properly decode a transmission is transmitted at intervals in the data stream, such as where frequency synchronisation is required, although in the case of frequency synchronisation decoding may sometimes begin, perhaps at a lower quality, before frequency synchronisation information is received and the frequency synchronisation information only fine tunes the receiver.

According to a first aspect of the present invention there is provided a method of transmitting a stream of differentially encoded data, comprising transmitting a stream of differential data portions, transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information at intervals in the data stream at a rate related to the rate at which complete data portions are transmitted.

According to a second aspect of the present invention, there is provided an apparatus for transmitting a stream of differentially encoded data, comprising means for transmitting a stream of differential data portions; means for transmitting complete data portions at intervals in the data stream; and means for transmitting synchronisation information at intervals in the data stream at a rate related to the rate at which the complete data portions are transmitted.

In the present invention, the rate of transmission of synchronisation information is dependent upon the rate of transmission of the complete data portions in the differentially encoded data stream. This contrasts with the prior art where synchronisation information is usually simply transmitted at fixed intervals, without regard to the rate of transmission of the complete data portions.

The Applicants have recognised that coordinating the transmission of synchronisation information and of complete data portions allows more efficient transmission of synchronisation information. For example, it can facilitate avoiding the transmission of redundant synchronisation information where there is no transmission of complete data portions, as in the present invention the amount of synchronisation information transmitted is reduced when the amount of complete data portions transmitted is reduced.

Preferably, the rate of transmission of synchronisation information is proportional to the rate of transmission of complete data portions. Preferably, m preceding synchronisation information portions (e.g. frames or data packets) are transmitted for every nth complete data portion, where n, m = 1, 2, 3,...(i.e. are integers greater than zero).

In a particularly preferred embodiment of the present invention, the rate of transmission of synchronisation information is the same as the rate of transmission of complete data portions. Thus, one synchronisation information portion is transmitted for each complete data portion (i.e. n=1, m=1). This helps to ensure that late-entry can usually be effected each time a complete data portion is transmitted.

Alternatively, it may be preferable to transmit synchronisation information at a rate higher than the rate of transmission of complete data portions (i.e. n=1, m > 1). This can help to facilitate late entry. Where two or more synchronisation information portions are transmitted for a given complete data portion, they are preferably spaced apart in the data stream so as to reduce the risk of all the synchronisation information portions being lost by a failure to receive a given part of the data stream (e.g. due to a fade in a radio transmission).

In another alternative, it may be preferable to transmit synchronisation information at a rate lower than the rate of transmission of complete data portions (i.e. n > 1, m=1). For example, in established and stable transmission channels or links where error recovery and late entry are unimportant, a lower rate of transmission of synchronisation information can be accepted and is advantageous as, where synchronisation data is transmitted by data addition, the overall amount of data transmitted is reduced, and where synchronisation data is transmitted by data stealing, the amount of signal information replaced with synchronisation information is reduced.

The position of the synchronisation information in the data stream can vary relative to each complete data portion. However, in a particularly preferred embodiment, the synchronisation information is always transmitted at a predetermined position in the data stream relative to the position of its next succeeding complete data portion. This is again believed to help facilitate the more efficient inclusion of synchronisation information in a differentially encoded data transmission.

Thus according to a third aspect of the present invention, there is provided a method of transmitting a stream of differentially encoded data, comprising: transmitting a stream of differential data portions; transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information portions at intervals in the data stream, wherein each synchronisation information portion is transmitted at a predetermined position in the data stream relative to the position in the data stream of its next succeeding complete data portion.

According to a fourth aspect of the present invention, there is provided an apparatus for transmitting a stream of differentially encoded data, comprising: means for transmitting a stream of differential data portions; means for transmitting complete data portions at intervals in the data stream; and means for transmitting synchronisation information portions at intervals in the data stream, with each synchronisation information portion being transmitted at a predetermined position in the data stream relative to the position in the data stream of its next succeeding complete data portion.

As discussed above, preferably one, but possibly two or more, synchronisation information portions are transmitted for each complete data portion in the data stream, although as noted above, this is not always necessary or desirable.

In a particularly preferred embodiment the synchronisation information is positioned closer to the next succeeding complete data portion in the data stream than to the last preceding complete data portion. This has the advantage of reducing the delay after receipt of a synchronisation frame before signal recovery or late entry can be achieved. It also has the advantage of reducing the probability of losing synchronisation between receipt of the synchronisation data and the arrival of the next complete data portion.

The Applicants have also recognised that, as it is necessary to first receive synchronisation information and then to receive a complete data portion to recover a differentially encoded data transmission that includes synchronisation information or to achieve late-entry to such a transmission, then a gap between receipt of synchronisation information and complete data portions will delay successful decoding after attempted signal recovery or late entry and also result in redundant processing of received differential data portions that the receiver cannot yet decode.

Any such delay and redundant signal processing is reduced by transmitting synchronisation information closely or preferably immediately prior to the next succeeding complete data portion. In this way, the time interval between synchronisation information and the following complete data portion in the data stream, and accordingly the time between attempted recovery or late-entry and successful decoding is reduced.

The delay can be minimised by transmitting each synchronisation information portion immediately adjacent to the next succeeding complete data portion. There will then be a minimum possible delay between receiving synchronisation information and receiving a complete data portion. Thus most preferably synchronisation data immediately precedes a complete data portion in the data stream (i.e. there are no differential data portions between the synchronisation information portion and the following complete data portion). This also has the particular advantage that, when the synchronisation information portion is included in the data stream by "stealing" a differential data portion, or part of one, the data stream immediately recovers using the succeeding complete data portion, and data loss or signal degradation is minimised.

According to a fifth aspect of the present invention, there is provided a method of transmitting a stream of differentially encoded data, comprising: transmitting a stream of differential data portions; transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information portions at intervals in the data stream, the synchronisation information portions being closer to the next succeeding complete data portion than to the last preceding complete data portion.

According to a sixth aspect of the present invention there is provided an apparatus for transmitting a stream of differentially encoded data, comprising: means for transmitting a stream of differential data portions; means for transmitting complete data portions at intervals in the data stream; and means for transmitting synchronisation information portions at intervals in the data stream, each synchronisation information portion being transmitted closer to the next succeeding complete data portion than to the last preceding complete data portion.

Thus, synchronisation information portions are transmitted closer to the complete data portion that follows than to that which is before the respective synchronisation information portion. This has the advantage of keeping the time period between receipt of a synchronisation information portion and a complete data portion short.

The present invention is particularly applicable to the transmission of differentially encoded video data. In that case the complete data portions will generally be I frames, which will be transmitted at intervals in a stream of differential P and/or B frames. The synchronisation information is then sent as synchronisation frames in the video data frame stream.

It is also particularly applicable to the transmission of encrypted differentially encoded data where the synchronisation information would then comprise encryption synchronisation information or data portions.

It is also applicable to situations where a variable transmission rate can be used, e.g. to share fixed rate radio channels between different applications. Variable rate transmissions may require synchronisation information to be transmitted frequently to maintain synchronisation, because, unlike in fixed rate transmissions, it may not be possible to maintain synchronisation simply by synchronising internal clocks in the transmitter and receiver.

The invention is also particularly applicable to data transmission by radio, since in radio transmissions loss of synchronisation can be common, as might be the case when signal quality is poor and sections of the transmission are not received properly.

Furthermore, radio transmissions often involve group calls in which more than one receiver, or member of the group call, receives a transmission. The receivers may start to receive the transmission, i.e. the members may join the call, at different times. This is referred to as late-entry and, as described above, requires synchronisation information and a complete data portion.

The invention thus extends to a radio receiver and a mobile radio unit of a mobile radio communications system comprising any or all of the apparatus of the present invention described above.

The means for carrying out methods in accordance with the present invention may comprise pure hardware means such as discrete components or hard-wired logic gates. Alternatively, the methods may be implemented at least partially using software e.g. computer programs. It will thus be seen that when viewed from a further aspect the present invention provides computer software specifically adapted to carry out the methods hereinabove described when installed on data processing means, and a computer program element comprising computer software code portions for performing the methods hereinabove described when the program element is run on a computer. The invention also extends to a computer software carrier comprising such software which when used to operate a data transmitting apparatus comprising a digital computer causes in conjunction with said computer said system to carry out the steps of the method of the present invention. Such a computer software carrier could be physical storage medium such as a ROM chip, CD ROM or disk, or could be a signal such as an electronic signal over wires, an optical signal or a radio signal such as to a satellite or the like.

It will further be appreciated that not all steps of the method of the invention need be carried out by computer software and thus from a further broad aspect the present invention provides computer software and such software installed on a computer software carrier for carrying out at least one of the steps of the methods set out hereinabove.

A number of preferred embodiments of the present invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:-

Figure 1 is an illustration of a method of differentially encoding video data;

Figure 2 is an illustration of a method of further compressing differentially encoded video data;

Figure 3 is an illustration of a stream of encoded video data according to the prior art; and

Figure 4 is an illustration of a stream of encoded video data according to a preferred embodiment of the present invention.

The invention will be illustrated by reference to transmitting encrypted differentially encoded video data, although, as will be appreciated by those skilled in the art, it is applicable to the transmission of all forms of differentially encoded data.

Figure 1 shows a method of differentially encoding video information. As shown in Figure 1, a prediction frame P(n) is formed for an input frame X(n) using both the input frame X(n) and previous and/or future input frames $X(n \pm m)$. The prediction frame P(n) is then subtracted from the input frame X(n) to produce a differential frame Y(n).

As shown in Figure 2, compression is then performed on the differential frames Y(n) to reduce the amount of data that needs to be transmitted. Each frame Y(n) is acted upon by an operation f() to produce an output frame Z(n), as illustrated in Figure 2.

There are generally three types of output frames Z(n) transmitted in a differentially encoded video signal. The first are INTRA coded (I) frames which are complete data frames and generally correspond with the input frame X(n) and thus can be used on their own to reconstruct (and thus recover) the relevant data. In other words, output I frames Z(n) are output frames Z(n) for which the prediction frame P(n) was zero. The first output frame in a sequence Z(0) will typically be an I frame as no previous frames are available to form a prediction frame P(0). In standards such as H.263, MPEG-1 or MPEG-2, I frames are typically produced at regular intervals to limit the accumulation of errors. However, I frames may also be sent at varying intervals. For example, the interval may be varied according to the amount of variation in the image or the error rate of the transmission.

The other two types of frames are differentially encoded frames. There are two such frames. INTER coded (P) frames are output frames Z(n) containing the differences between the input frame X(n) and a prediction frame P(n) formed from input frames X(n-m) preceding or prior to the respective input frame X(n). Bi-directionally predicted (B) frames are output frames Z(n), containing the differences between input frames X(n) and a prediction frame P(n) formed from both past and future input frames X(n ± m). P and B frames typically contain less data than an I frame, as P and B frames contain only differential information.

The transmitted video data bit stream will therefore contain a stream of I, P and B frames. I frames are sent less frequently in the compressed bit stream than P and B frames because they contain more data.

Consider now the transmission of an encrypted video data stream. The data stream will, as is known in the art, also include encryption synchronisation information portions or frames to allow the receiver to successfully decode the output frames Z(n) in the data stream. The encryption synchronisation information could, for example, comprise an indication of the encryption key currently being used by the data encoder, or a pointer to the synchronisation position to be used in a key stream cipher for e.g. the next piece of data or the next complete data portion.

At the beginning of a transmission an encryption synchronisation frame is transmitted in the compressed bit stream. This allows the decoder or decryption mechanism to synchronise with the encoder or encryption mechanism. Furthermore, encryption synchronisation frames are transmitted throughout the transmission at intervals to allow users to join the transmission after the start and to allow recovery from transmission errors. Encryption synchronisation frames may be included in the data bit stream by addition to or stealing from the bit stream.

Figure 3 illustrates a typical video data bit stream 11. It includes a stream of P or B frames 10 with encryption synchronisation frames 9 being transmitted at regular intervals in the data stream, and I frames 8 transmitted at intervals. A user starting to receive the transmission (making a late entry attempt) at a point 12 has to wait until the synchronisation frame 9 labelled D to receive encryption synchronisation information, thereby giving an encryption synchronisation time period 13. There are then four P or B frames 10 for which the decoder will have encryption synchronisation information but no I frame 8 with which to combine the P or B frames 10 received. Decoding cannot therefore occur successfully until the I frame 8 labelled E has been received, giving an overall video synchronisation time period 14. This causes an undesirable delay.

In this arrangement, the minimum delay or overall synchronisation time 15 is the time between receipt of an encryption synchronisation frame 9 and an I frame 8. The maximum delay or overall synchronisation time 16, under good transmission conditions, is the time from immediately after the transmission of a first encryption synchronisation frame 9, e.g. that labelled B, to the end of transmission of both a further encryption synchronisation 9, e.g. that labelled D, and a subsequent I frame 8, e.g. that labelled E.

As shown in Figure 4, in the preferred embodiment of the present invention encryption synchronisation frames 9 are sent immediately prior to I frames 8. This ensures that, no matter where a user begins receipt of the data bit stream 20, both encryption synchronisation information in the form of an encryption synchronisation frame 9 and an I frame 8 will be received in quick succession and decoding will commence with a minimum delay between receipt of the encryption synchronisation frame and receipt of the complete I frame 8.

Furthermore, the frequency with which I frames 8 are transmitted may vary according to the nature of the video data encoded. As encryption synchronisation frames 9 are sent immediately prior to each and every I frame 8, the rate of transmission of encryption synchronisation frames 9 varies automatically with the rate of transmission of I frames 8, and no unnecessary encryption synchronisation frames 9 are sent.

Sending one encryption synchronisation frame 9 close to and preceding each I frame 8 ensures that the video encryption synchronisation takes no longer than the period between successive I frames. This is then maximum delay or synchronisation time 25 that occurs in good transmission conditions. The minimum possible delay or synchronisation time 24 is the time elapsed between the receipt of an encryption synchronisation frame 9 and the completion of the immediately succeeding I frame 8. In general, the time delay or synchronisation time 23 will be the time elapsed between the start of the encryption synchronisation error or late entry attempt 21 and the completion of the next I frame 8.

In the above embodiment, one encryption synchronisation frame is transmitted for each I frame. In general, it is preferred that for every nth I frame 8 there are m preceding encryption synchronisation frames 9, where n, m = 1, 2, 3, etc. Thus m can be varied according to how often it is desired to send encryption synchronisation frames 9. For example, m may be increased when transmission/reception quality is poor and/or a large number of late-entry attempts are expected.

Although described above with reference to the transmission of encryption synchronisation information, the invention is applicable to the transmission of all forms of synchronisation data that is sent at intervals in a differentially encoded data stream. Thus, it applies to, for example, the transmission of frequency synchronisation frames, which may be transmitted in the same way as described above with reference to encryption synchronisation frames. This is of particular use in systems in which transmitters use their own best estimate of a frequency for their transmission and transmit frequency information regarding their transmission frequency to the receivers. This occurs particularly in direct mode mobile radio communications (i.e. where communication takes place independently of a fixed radio network) in which the frequency used for transmission may vary according to which individual mobile unit is transmitting at a given time.

Claims

1. A method of transmitting a stream of differentially encoded data, comprising transmitting a stream of differential data portions, transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information at intervals in the data stream at a rate related to the rate at which complete data portions are transmitted.

2. The method of claim 1, wherein the rate of transmission of synchronisation information is proportional to the rate of transmission of complete data portions.

3. The method of claim 1 or claim 2, wherein the rate of transmission of synchronisation information is the same as the rate of transmission of complete data portions.

4. The method of claim 1 or claim 2, wherein the synchronisation information is transmitted at a rate higher than the rate of transmission of complete data portions.

5. The method of claim 1 or claim 2, wherein the synchronisation information is transmitted at a rate lower than the rate of transmission of complete data portions.

6. The method of any one of the preceding claims, wherein the synchronisation information is always transmitted at a predetermined position in the data stream relative to the position of its next succeeding complete data portion.

7. A method of transmitting a stream of differentially encoded data, comprising: transmitting a stream of

differential data portions; transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information portions at intervals in the data stream, wherein each synchronisation information portion is transmitted at a predetermined position in the data stream relative to the position in the data stream of its next succeeding complete data portion.

8. The method of claim 6 or claim 7, wherein one or more synchronisation information portions are transmitted for each complete data portion in the data stream.

9. The method of any one of claims 6 to 8, wherein the synchronisation information is positioned in the data stream closer to the next succeeding complete data portion in the data stream than to the last preceding complete data portion.

10. A method of transmitting a stream of differentially encoded data, comprising: transmitting a stream of differential data portions; transmitting complete data portions at intervals in the data stream; and transmitting synchronisation information portions at intervals in the data stream, the synchronisation information portions being transmitted closer to the next succeeding complete data portion than to the last preceding complete data portion.

11. The method of any one of claims 6 to 10, wherein synchronisation information immediately precedes a complete data portion in the data stream.

12. An apparatus for transmitting a stream of differentially encoded data, comprising means for transmitting a stream of differential data portions; means for transmitting complete data portions at

intervals in the data stream; and means for transmitting synchronisation information at intervals in the data stream at a rate related to the rate at which the complete data portions are transmitted.

13. The apparatus of claim 12, wherein the means for transmitting synchronisation information transmits the synchronisation information at a rate proportional to the rate of transmission of complete data portions.

14. The apparatus of claim 12 or claim 13, wherein the means for transmitting synchronisation information transmits the synchronisation information at a rate the same as the rate of transmission of complete data portions.

15. The apparatus of claim 12 or claim 13, wherein the means for transmitting synchronisation information transmits the synchronisation information at a rate higher than the rate of transmission of complete data portions.

16. The apparatus of claim 12 or claim 13, wherein the means for transmitting synchronisation information transmits the synchronisation information at a rate lower than the rate of transmission of complete data portions.

17. The apparatus of any one of claims 13 to 17, wherein the means for transmitting synchronisation information always transmits the synchronisation information at a predetermined position in the data stream relative to the position of the next succeeding complete data portion.

18. An apparatus for transmitting a stream of differentially encoded data, comprising: means for transmitting a stream of differential data portions;

means for transmitting complete data portions at intervals in the data stream; and means for transmitting synchronisation information portions at intervals in the data stream, in such a manner that each synchronisation information portion is transmitted at a predetermined position in the data stream relative to the position in the data stream of its next succeeding complete data portion.

19. The apparatus of claim 17 or claim 18, wherein the means for transmitting synchronisation information positions synchronisation information in the data stream closer to the next succeeding complete data portion in the data stream than to the last preceding complete data portion.

20. An apparatus for transmitting a stream of differentially encoded data, comprising: means for transmitting a stream of differential data portions; means for transmitting complete data portions at intervals in the data stream; and means for transmitting synchronisation information portions at intervals in the data stream in such a manner that each synchronisation information portion is transmitted closer to the next succeeding complete data portion than to the last preceding complete data portion.

21. The apparatus of any one of claims 17 to 20, wherein the means for transmitting synchronisation information positions synchronisation information in the data stream immediately preceding a complete data portion.

22. The method or apparatus of any one of the preceding claims, wherein the complete data portions and differential data portions comprise a video data frame stream and the synchronisation information is sent as synchronisation frames in the video data frame stream.

23. The method or apparatus of any one of the preceding claims, wherein the synchronisation information comprises encryption synchronisation data portions.

24. The method or apparatus of any one of claims 1 to 23, wherein the synchronisation information comprises frequency synchronisation data portions.

25. A radio receiver or a mobile radio unit of a mobile radio communications system, comprising the apparatus of any one of claims 12 to 21.

26. Computer software comprising computer software code portions for performing the method of any one of claims 1 to 11 or 22 to 24 when said software is run on a computer.

27. An apparatus for transmitting a stream of differentially encoded data substantially as hereinbefore described with reference to any one of the accompanying drawings.

28. A radio receiver or mobile unit substantially as hereinbefore described with reference to any one of the accompanying drawings.

29. A method of transmitting a stream of differentially encoded data substantially as hereinbefore described with reference to any one of the accompanying drawings.

INVESTOR IN PEOPLE

Application No: GB 0016792.4
Claims searched: All

Examiner: Gareth Griffiths
Date of search: 20 October 2000

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.R): H4M (MTB1, MTB3), H4P (PDCFP, PEP, PSB)

Int Cl (Ed.7): H03M 7/00, H04B 14/06, 7/26, H04L 7/04, 7/08, H04N 7/52, 7/54, 7/56

Other: Online Databases: WPI, EPODOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
	NONE	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
		E	Patent document published on or after, but with priority date earlier than, the filing date of this application.
&	Member of the same patent family		